Exhibit 4

U.S. Patent No. 10,242,456V. PTC Inc.

1. Claim Chart

| Claim	Analysis
[1.P] An augmented reality (AR) method comprising:	PTC Inc. ("Defendant") performs and induces others to perform an augmented reality (AR) method. This element is infringed literally, or in the alternative, under the doctrine of equivalents. For example, Defendant provides Vuforia View application for iOS and Android which provides an interface in which a 3D model is augmented on an input image of a physical environment. The Vuforia View app obtains an image of the physical environment as an input image and identifies a mark (called ThingMark) in the image such that a 3D model of a virtual object is overlayed on the mark. Further, Defendant provides a Vuforia Studio application for creating and publishing the mark to Vuforia Experience Service. In Vuforia Studio, a user can create a ThingMark and associate x, y, and z coordinates with the ThingMark before publishing it to Vuforia Experience Service. The Vuforia Experience Service stores a list of options (denoted as experiences) associated with the ThingMark. The Vuforia View app retrieves the experiences from the Vuforia Experience Service when ThingMark is scanned by the user and displays a 3D model by overlaying on the input image, based on the experience selected by the user.

Source: https://community.ptc.com/sejnu66972/attachments/sejnu66972/CommunityNetworkingDiscussions/1027/1/455_Gerdes_20160624_1359.pdf Page 10
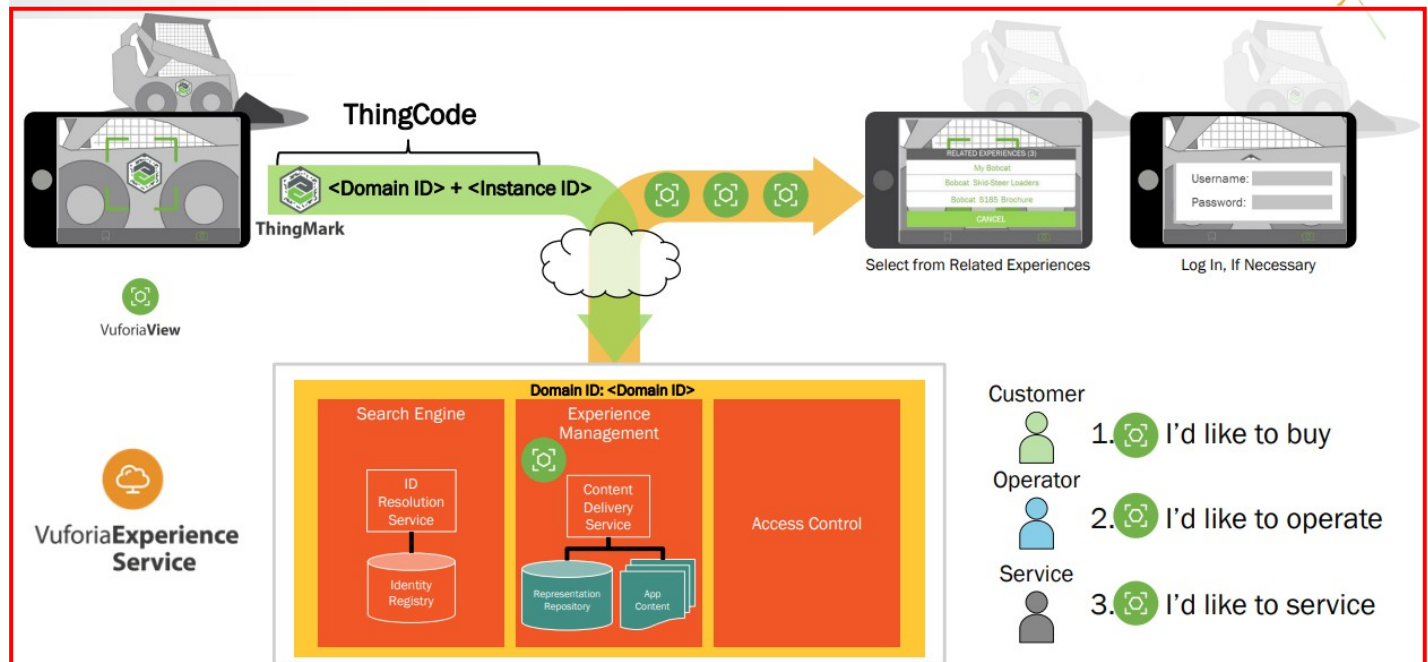
Source:
https://community.ptc.com/sejnu66972/attachments/sejnu66972/CommunityNetworkingDiscussions/1027/1/455_Gerdes_20160624_1359.pdf Page 36

Source:
https://community.ptc.com/sejnu66972/attachments/sejnu66972/CommunityNetworkingDiscussions/1027/1/455_Gerdes_20160624_1359.pdf Page 42

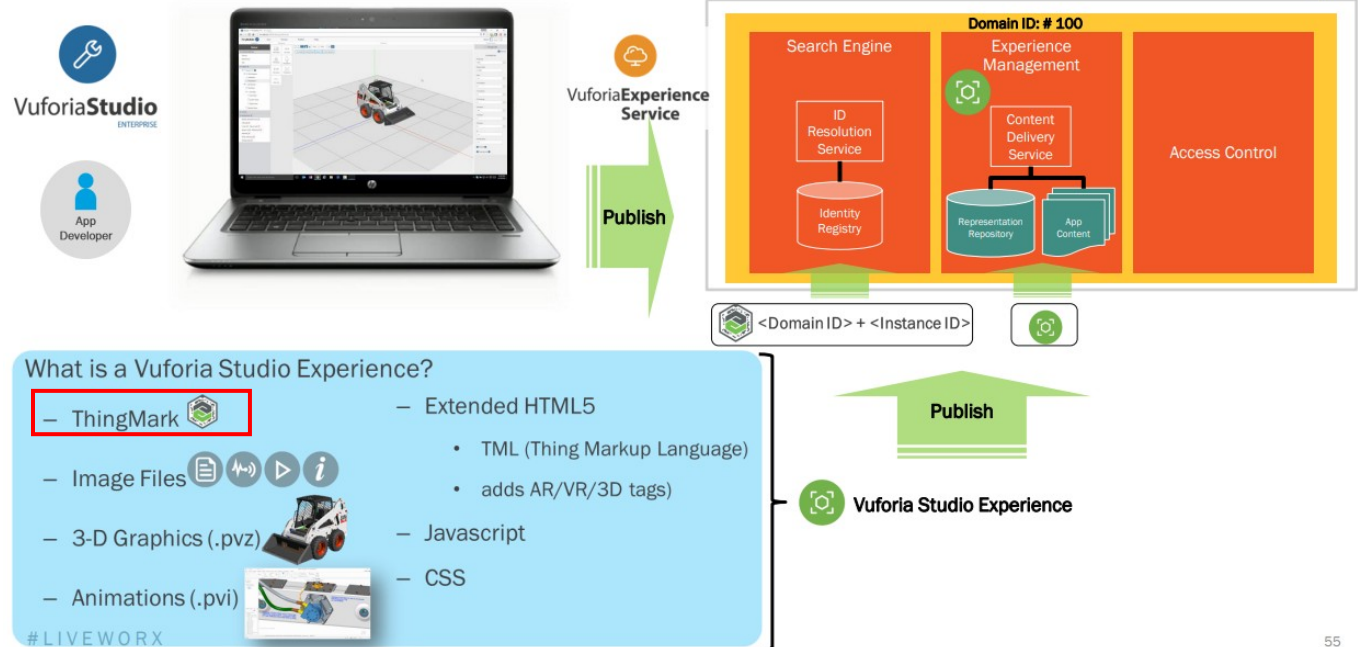Vuforia View allows users to access and share Augmented Reality experiences, that are rich with 3D content and IoT data on mobile devices and digital eyewear across the enterprise. Vuforia View brings products to life and empowers your workforce with immersive user interactions that are created in Vuforia Studio, a rapid authoring environment for scalable AR experiences.

Download Vuforia View today to experience the value that Vuforia Augmented Reality can bring to your business.

Getting started is easy:
1) Open the Vuforia View Gallery
2) Select an experience
3) Enjoy your AR experience

Source: https://play.google.com/store/apps/details?id=com.ptc.vuforiaview&hl=en&gl=US

6

How to use Vuforia View:

1. Open the Vuforia View app on your mobile or eyewear device.

2. Depending on the tracking method used in the experience you want to view, access it using one of the following methods:

   ○ If your experience uses Model Tracking, open your Library and select the experience. Then, point your camera at the physical object ensuring that the digital wireframe lines up with the object correctly.

   ○ If your experience uses Spatial Tracking, open your Library and select the experience. Then, point your device at a flat surface and place the model in your environment.

   ○ If your experience uses a ThingMark, scan the ThingMark instead. If multiple experiences are associated to the ThingMark, select the appropriate one.

3. Once your ThingMark or object has been scanned successfully, a list of Vuforia Studio AR experiences appears.

4. Select an experience. Wait a moment for your experience to load. You may need to step away from the object to view the entire experience.

5. Now you're ready to interact with the experience.

Source: https://www.ptc.com/en/success-paths/develop-first-vuforia-studio-experience/setup/get-started-with-devices

7

Vuforia View Enterprise allows people to experience products in a whole **new way** using a **unique** approach that understands "Things".

Vuforia View Enterprise delivers **rich, use-case specific mobile user experiences** of seamlessly connected **product data**

These Experiences are enhanced by **3D product navigation** and **augmented reality** interaction.

Source: https://community.ptc.com/sejnu66972/attachments/sejnu66972/CommunityNetworkingDiscussions/1027/1/455_Gerdes_20160624_1359.pdf Page 7
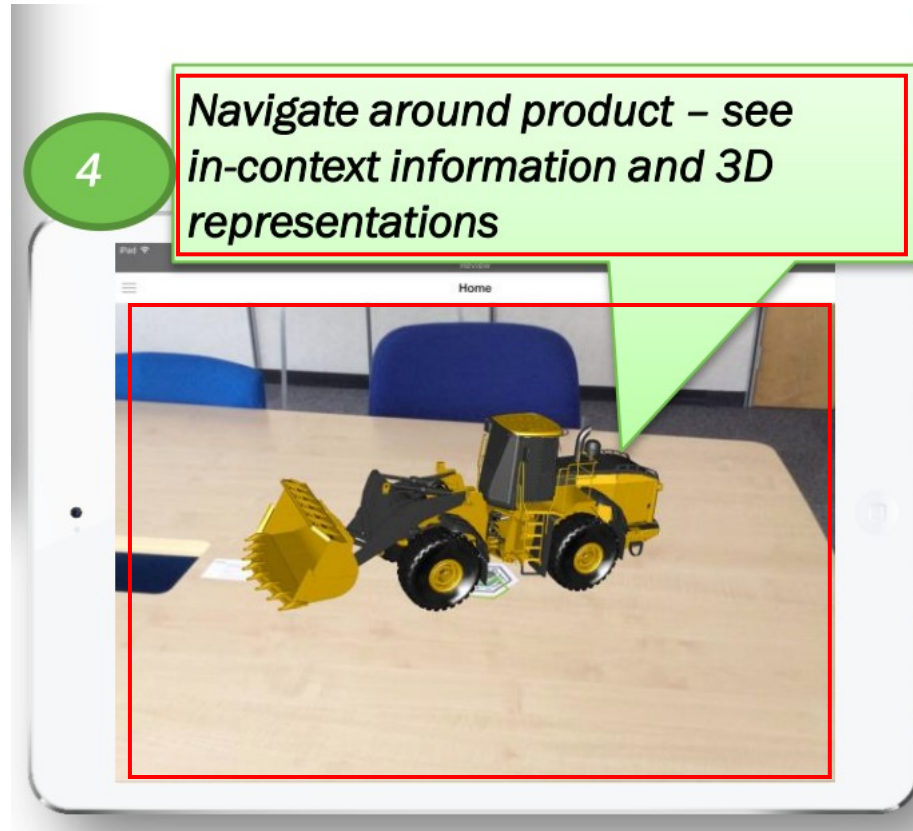
PTC Vuforia View delivers AR-enabled Experiences to the entire Enterprise

VUFORIA VIEW

Delivers augmented reality Experiences rich with 3D graphics and real-time product data.

Source: https://community.ptc.com/sejnu66972/attachments/sejnu66972/CommunityNetworkingDiscussions/1027/1/455_Gerdes_20160624_1359.pdf Page 9

Source:
https://community.ptc.com/sejnu66972/attachments/sejnu66972/CommunityNetworkingDiscussions/1027/1/455_Gerdes_20160624_1359.pdf Page 10 (annotated)
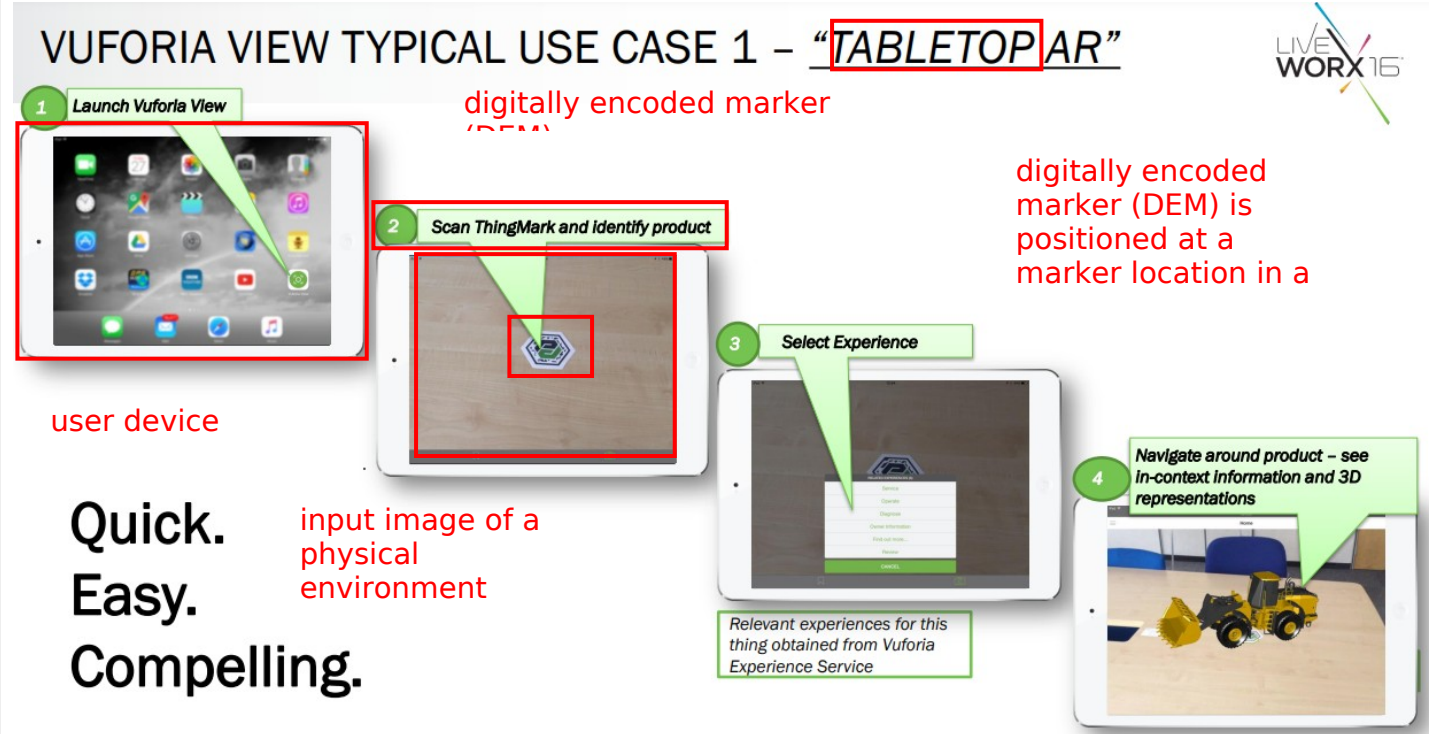
[1.1] operating a camera of the user device to acquire an input image of a	Defendant performs and induces others to perform the step of operating a camera of the user device to acquire an input image of a physical environment, wherein a digitally encoded marker (DEM) is positioned at a marker location within the physical environment.

| physical environment, wherein a digitally encoded marker (DEM) is positioned at a marker location within the physical environment; | This element is infringed literally, or in the alternative, under the doctrine of equivalents.

For example, the Vuforia View app allows the user to obtain an image ("input image") of the physical environment using the mobile device ("user device") on which the Vuforia View app is installed. Further, the obtained image comprises a ThingMark ("digitally encoded marker") which is a coded marker placed at a marker location in the physical environment.

Source: https://community.ptc.com/sejnu66972/attachments/sejnu66972/CommunityNetworkin |

gDiscussions/1027/1/455_Gerdes_20160624_1359.pdf Page 10 (annotated)

Source:
https://community.ptc.com/sejnu66972/attachments/sejnu66972/CommunityNetworkin
gDiscussions/1027/1/455_Gerdes_20160624_1359.pdf Page 32   Source:

11

Source: https://www.ptc.com/en/products/vuforia/augmented-reality-features

How to use Vuforia View:

1. Open the Vuforia View app on your mobile or eyewear device.

2. Depending on the tracking method used in the experience you want to view, access it using one of the following methods:

    ○ If your experience uses Model Tracking, open your Library and select the experience. Then, point your camera at the physical object ensuring that the digital wireframe lines up with the object correctly.

    ○ If your experience uses Spatial Tracking, open your Library and select the experience. Then, point your device at a flat surface and place the model in your environment.

    ○ If your experience uses a ThingMark, scan the ThingMark instead. If multiple experiences are associated to the ThingMark, select the appropriate one.

3. Once your ThingMark or object has been scanned successfully, a list of Vuforia Studio AR experiences appears.

4. Select an experience. Wait a moment for your experience to load. You may need to step away from the object to view the entire experience.

5. Now you're ready to interact with the experience.

Source: https://www.ptc.com/en/success-paths/develop-first-vuforia-studio-experience/setup/get-started-with-devices

12

	It's time to view the completed project! 1. Place the appropriate ThingMark on a flat surface where you can easily interact with it. 2. From your supported mobile device, open Vuforia View. 3. Point the camera of your device at the ThingMark. 4. Vuforia View alerts you with a sound or vibration once the ThingMark has been scanned successfully, and a list of available experiences appears. The experiences in the list have all been associated with the particular ThingMark that you scanned. 5. Select the **Blue Pump Demo** experience you just published. 6. Wait a moment with your device still pointed at the ThingMark. 💬 If the model is large, a progress indicator appears. Try not to move the mobile device until this loading process completes. Slowly move your mobile device further away from the ThingMark so that you can view the entire experience. 7. Once the experience loads, you can interact with the various components of your AR experience: ◦ As you move the mobile device around (while still pointed at the ThingMark), the blue pump moves as well. This allows you to view the model from different angles. ◦ The 3D label displaying the RPM value is visible, and the value changes every 3 seconds. In addition, the 3D Label is always be facing towards you, regardless of how you move around the ThingMark. ◦ If you press the Play button one time, the disassembly animation plays. If you press the Play button a second time, the pump reassembles itself. ◦ If you press the Info button, the card appears in the middle of the screen with the information you added. If you press the Info button again, the information disappears. ◦ If you press the "i" button, the 3D Label appears or disappears each time your press it. Source: http://support.ptc.com/help/vuforia/studio/en/index.html#page/Studio_Help_Center/BPAdvancedViewInView.html
[1.2] with a processor, processing the input image to identify the DEM in the input image;	Defendant performs and induces others to perform the step of a processor, processing the input image to identify the DEM in the input image. This element is infringed literally, or in the alternative, under the doctrine of equivalents. For example, the Vuforia View app identifies the ThingMark when the camera of the mobile device is pointed at the location of ThingMark in physical environment. Since the app is run by the processor of the mobile device, the ThingMark is identified in the input image by using the processor of the mobile device.

Source: https://community.ptc.com/sejnu66972/attachments/sejnu66972/CommunityNetworkingDiscussions/1027/1/455_Gerdes_20160624_1359.pdf Page 10 (annotated)

It's time to view the completed project!

1. Place the appropriate ThingMark on a flat surface where you can easily interact with it.
2. From your supported mobile device, open Vuforia View.
3. Point the camera of your device at the ThingMark.
4. Vuforia View alerts you with a sound or vibration once the ThingMark has been scanned successfully, and a list of available experiences appears. The experiences in the list have all been associated with the particular ThingMark that you scanned.
5. Select the **Blue Pump Demo** experience you just published.
6. Wait a moment with your device still pointed at the ThingMark.

   💬 If the model is large, a progress indicator appears. Try not to move the mobile device until this loading process completes.

   Slowly move your mobile device further away from the ThingMark so that you can view the entire experience.
7. Once the experience loads, you can interact with the various components of your AR experience:

   ◦ As you move the mobile device around (while still pointed at the ThingMark), the blue pump moves as well. This allows you to view the model from different angles.

   ◦ The 3D label displaying the RPM value is visible, and the value changes every 3 seconds. In addition, the 3D Label is always be facing towards you, regardless of how you move around the ThingMark.

   ◦ If you press the Play button one time, the disassembly animation plays. If you press the Play button a second time, the pump reassembles itself.

   ◦ If you press the Info button, the card appears in the middle of the screen with the information you added. If you press the Info button again, the information disappears.

   ◦ If you press the "i" button, the 3D Label appears or disappears each time your press it.

Source:
http://support.ptc.com/help/vuforia/studio/en/index.html#page/Studio_Help_Center/BPAdvancedViewInView.html

15

A ThingMark is a **unique graphical identifier**, scanned by users with Vuforia View on their mobile devices, that

1 quickly identifies the unique thing and its relevant 'experiences'

2 aligns 3D information contextually and spatially with the physical thing

Scan a ThingMark

Source:
https://community.ptc.com/sejnu66972/attachments/sejnu66972/CommunityNetworkingDiscussions/1027/1/455_Gerdes_20160624_1359.pdf Page 32

[1.3] decoding data from the identified DEM including at least one of geographic coordinate data and relative coordinate data defining the marker location in the physical environment,	Defendant performs and induces others to perform the step of decoding data from the identified DEM including at least one of geographic coordinate data and relative coordinate data defining the marker location in the physical environment, wherein the decoding is performed without calculating coordinates of the DEM in the physical environment.

This element is infringed literally, or in the alternative, under the doctrine of equivalents.

For example, the Vuforia Studio application allows the user to create a ThingMark and encodes it with x, y, and z coordinates and publish the ThingMark to Vuforia Experience |

|	
wherein the decoding is performed without calculating coordinates of the DEM in the physical environment;	Service. The Vuforia View app scans the ThingMark ("identified DEM") and decodes the pattern on the ThingMark to obtain x, y, and z coordinates ("relative coordinate data") related to the ThingMark. Since the coordinates are obtained by decoding a pattern on the ThingMark, the ThingMark's coordinates in the physical environment are not calculated to obtain the relative coordinates. What Does This Widget Do? The ThingMark widget allows you to insert a ThingMark in an experience. A ThingMark is a uniquely identifiable marker that is universally recognizable by Vuforia View. ThingMarks must be recognizable to Vuforia View in order for the appropriate experiences and corresponding data to be delivered for the specific thing and use case. When Should I Use This Widget? Use a ThingMark when: • You want to align your physical object and digital model as closely as possible. In order for the 3D model to display in the correct location, you must place a digital ThingMark in the same location as your real-world ThingMark. For example, if you want to create an experience showing a service technician how to change the oil filter on a generator, you will want to augment the oil filter model and sequence of steps on top of the physical generator. • You want to create a tabletop experience. For example, if you want to show a potential customer a model of a generator without having to bring the physical generator, you would place the ThingMark on the floor of the canvas in the experience. Then, when on site, you would place the print out of the ThingMark on the floor, scan it, and the digital representation of the generator appears. Source: http://support.ptc.com/help/vuforia/studio/en/index.html#page/Studio_Help_Center%2FWidget3DMarker.html%23 Are There Any Special Properties, Services, Events, or Actions? To view a list of common widget properties, services, and events, see Common Widget Properties, Services, and Events. The following table is a list of properties that are specific to this widget. Source: http://support.ptc.com/help/vuforia/studio/en/index.html#page/Studio_Help_Center%2FWidget3DMarker.html%23

17

Property	JavaScript	Type	Description
ThingMark	markerId	string	ID of the ThingMark being used.
Marker Width	width	number	The width of the ThingMark. The value of this field is set in meters. For example, if your printed ThingMark is 5 centimeters, set this to 0.05.
X Coordinate	x	number	Location of the ThingMark on the x-axis.
Y Coordinate	y	number	Location of the ThingMark on the y-axis.
Z Coordinate	z	number	Location of the ThingMark on the z-axis.
X Rotation	rx	number	Rotation of the ThingMark about the x-axis.
Y Rotation	ry	number	Rotation of the ThingMark about the y-axis.
Z Rotation	rz	number	Rotation of the ThingMark about the z-axis.
Tracked	istracked	boolean	Tracked and Tracking Lost bindings.
Display Tracking Indicator	trackingIndicator	boolean	Displays an indicator that tracking is in progress.
Stationary (Eyewear projects only)	stationary	boolean	Select this checkbox if the ThingMark will be in a stable environment and won't be moved by the user.

Source:
http://support.ptc.com/help/vuforia/studio/en/index.html#page/Studio_Help_Center%2FWidget3DMarker.html%23 (annotated)

18
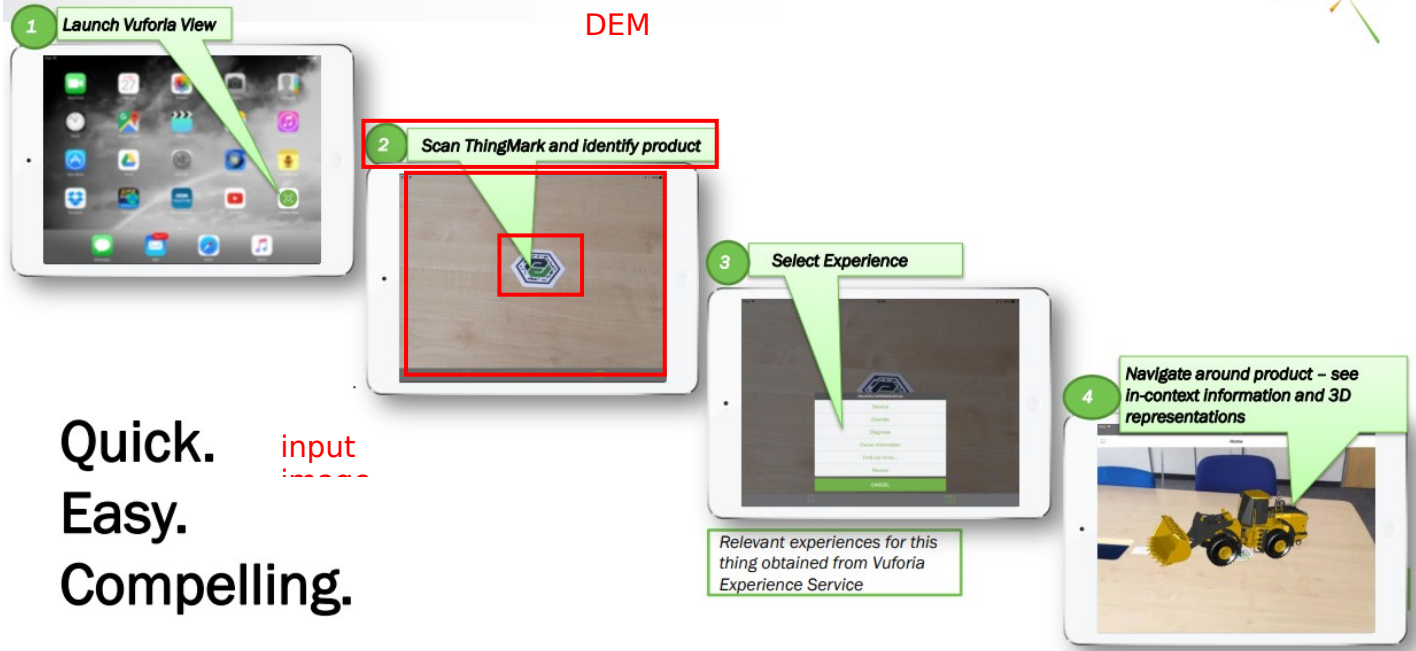
Source: https://community.ptc.com/sejnu66972/attachments/sejnu66972/CommunityNetworkingDiscussions/1027/1/455_Gerdes_20160624_1359.pdf Page 10 (annotated)
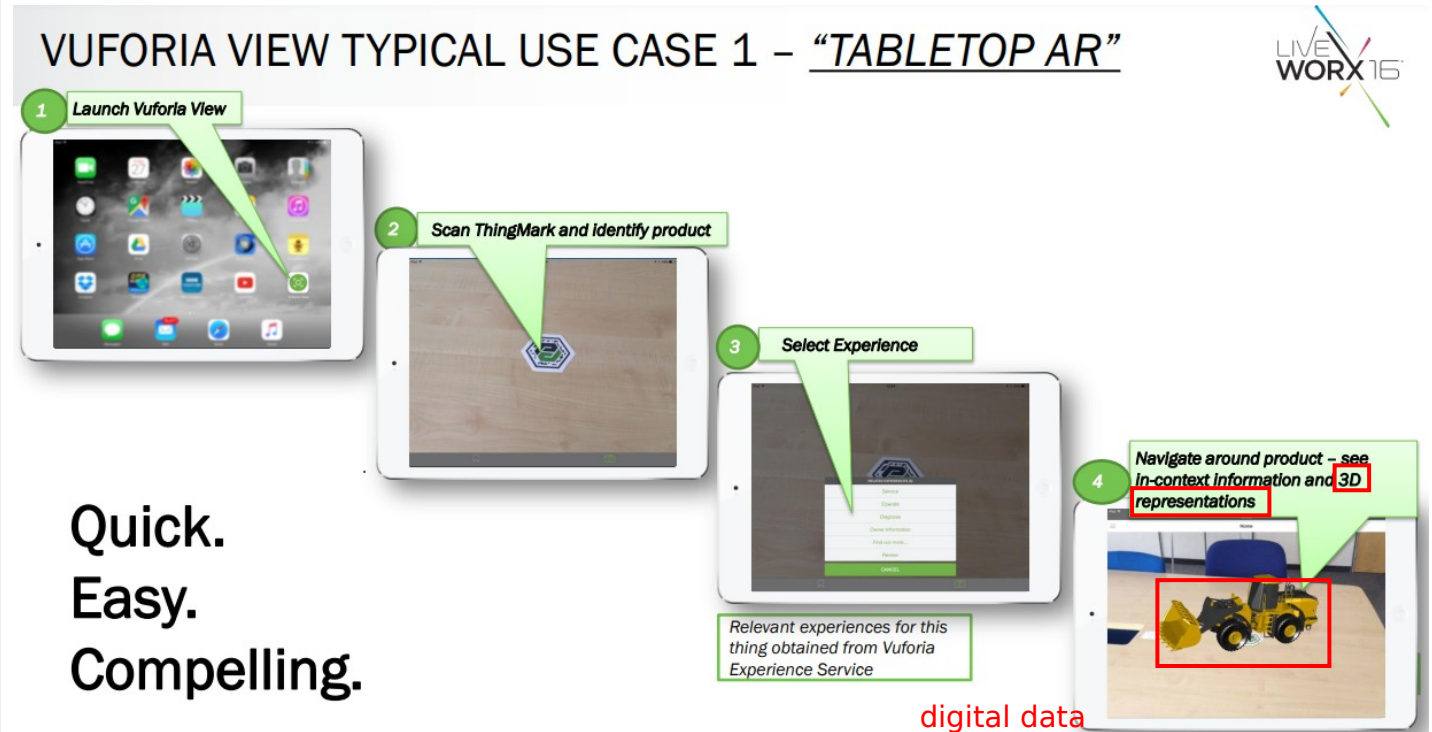
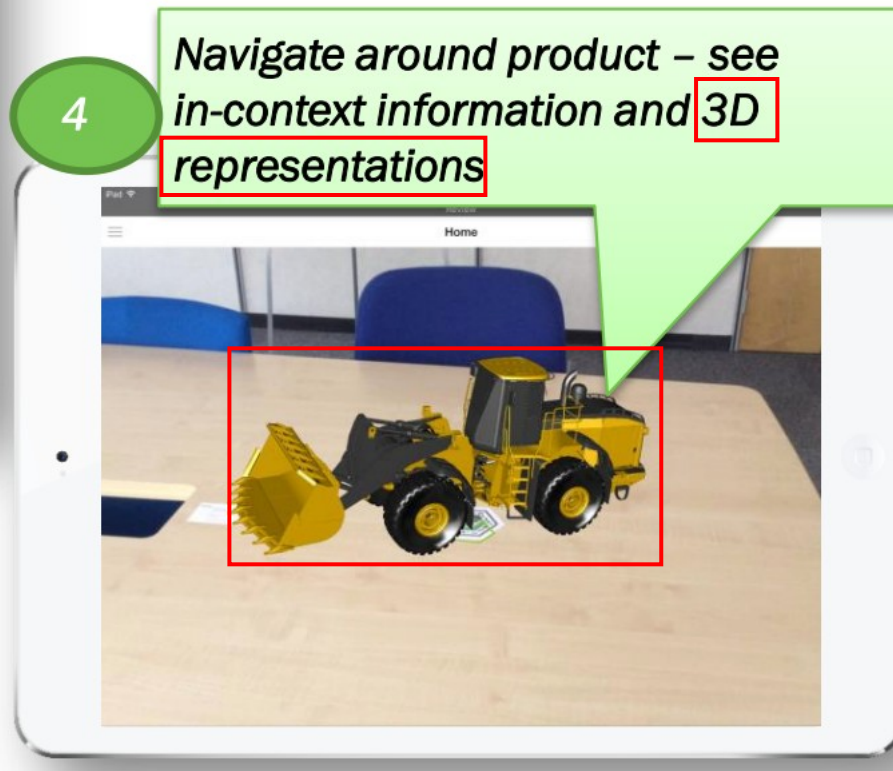| [1.4] from memory of the user device, retrieving digital data of a virtual object, wherein the virtual object is a 3D digital model; | Defendant performs and induces others to perform the step of, from memory of the user device, retrieving digital data of a virtual object, wherein the virtual object is a 3D digital model. This element is infringed literally, or in the alternative, under the doctrine of equivalents. For example, the Vuforia View app displays a 3D representation of a virtual object |

(such as a truck) that is linked to the ThingMark in Vuforia Studio. The virtual object is retrieved from the Vuforia Experience Service to be displayed in the Vuforia View app. Upon information and belief, the virtual object is at least temporarily stored in the memory of the mobile device before being displayed in the Vuforia View app.

Source: https://community.ptc.com/sejnu66972/attachments/sejnu66972/CommunityNetworkingDiscussions/1027/1/455_Gerdes_20160624_1359.pdf Page 10 (annotated)

20

Source:
https://community.ptc.com/sejnu66972/attachments/sejnu66972/CommunityNetworkingDiscussions/1027/1/455_Gerdes_20160624_1359.pdf Page 10 (annotated)

Use a ThingMark when:

- You want to align your physical object and digital model as closely as possible. In order for the 3D model to display in the correct location, you must place a digital ThingMark in the same location as your real-world ThingMark. For example, if you want to create an experience showing a service technician how to change the oil filter on a generator, you will want to augment the oil filter model and sequence of steps on top of the physical generator.

- You want to create a tabletop experience. For example, if you want to show a potential customer a model of a generator without having to bring the physical generator, you would place the ThingMark on the floor of the canvas in the experience. Then, when on site, you would place the print out of the ThingMark on the floor, scan it, and the digital representation of the generator appears.

Source:
http://support.ptc.com/help/vuforia/studio/en/index.html#page/Studio_Help_Center%2FWidget3DMarker.html%23

Place digital content anywhere with Vuforia

The advanced computer vision within PTC's Vuforia portfolio enables applications to recognize a specific part of the physical world, be it an image, model, or indoor space, so it can attach digital content to it.

Whether you're looking to create an engaging marketing application or an immersive training experience, Vuforia offers the most expansive set of features and technology to place your content wherever it's needed.

Source: https://www.ptc.com/en/products/vuforia/augmented-reality-features

It's time to view the completed project!

1. Place the appropriate ThingMark on a flat surface where you can easily interact with it.
2. From your supported mobile device, open Vuforia View.
3. Point the camera of your device at the ThingMark.
4. Vuforia View alerts you with a sound or vibration once the ThingMark has been scanned successfully, and a list of available experiences appears. The experiences in the list have all been associated with the particular ThingMark that you scanned.
5. Select the **Blue Pump Demo** experience you just published.
6. Wait a moment with your device still pointed at the ThingMark.

> 💬   If the model is large, a progress indicator appears. Try not to move the mobile device until this loading process completes.

Slowly move your mobile device further away from the ThingMark so that you can view the entire experience.

7. Once the experience loads, you can interact with the various components of your AR experience:

    ◦ As you move the mobile device around (while still pointed at the ThingMark), the blue pump moves as well. This allows you to view the model from different angles.

    ◦ The 3D label displaying the RPM value is visible, and the value changes every 3 seconds. In addition, the 3D Label is always be facing towards you, regardless of how you move around the ThingMark.

    ◦ If you press the Play button one time, the disassembly animation plays. If you press the Play button a second time, the pump reassembles itself.

    ◦ If you press the Info button, the card appears in the middle of the screen with the information you added. If you press the Info button again, the information disappears.

    ◦ If you press the "i" button, the 3D Label appears or disappears each time your press it.

Source:
http://support.ptc.com/help/vuforia/studio/en/index.html#page/Studio_Help_Center/BPAdvancedViewInView.html
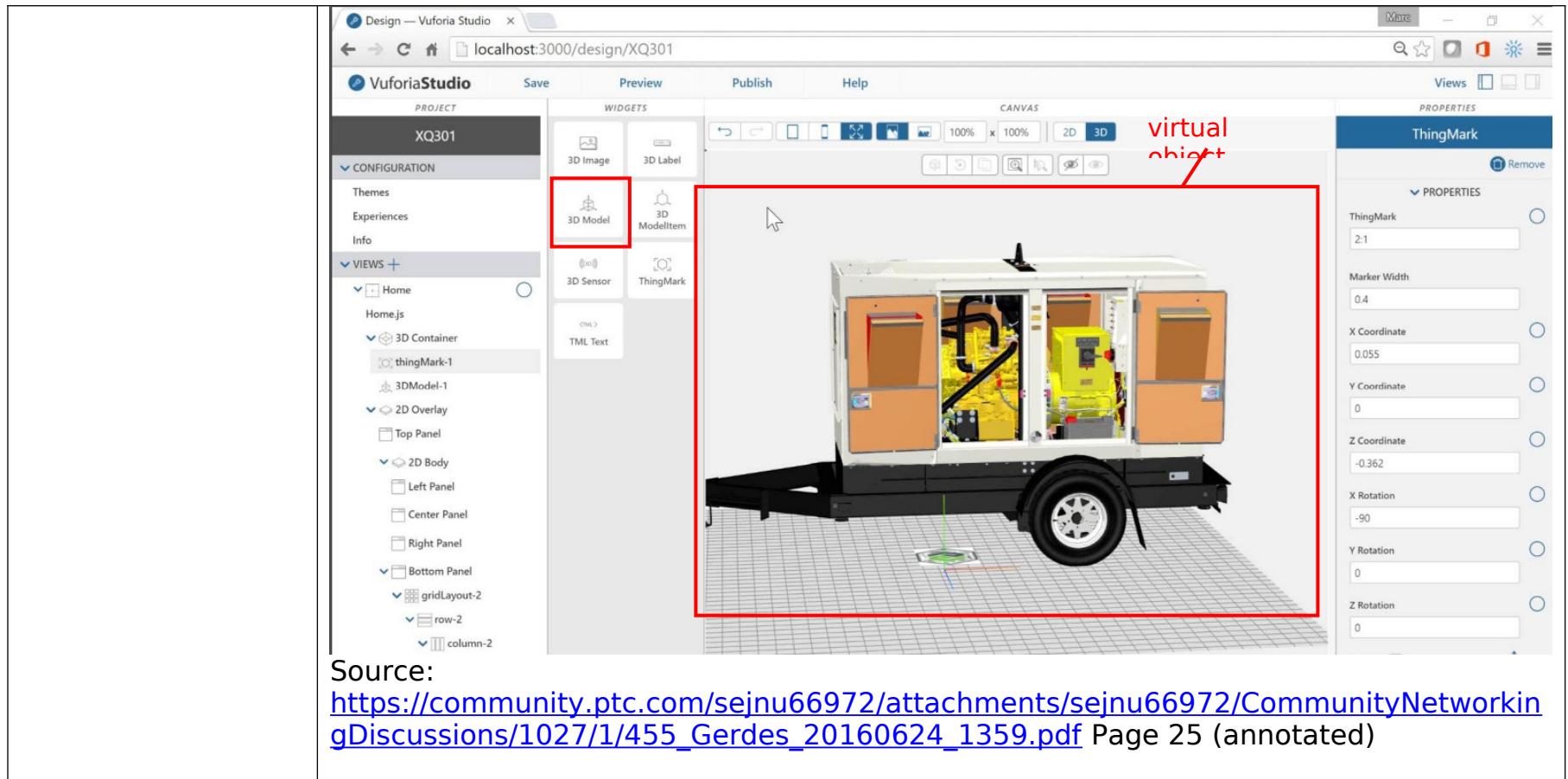
23

Source:
https://community.ptc.com/sejnu66972/attachments/sejnu66972/CommunityNetworkingDiscussions/1027/1/455_Gerdes_20160624_1359.pdf Page 32

Source:
https://community.ptc.com/sejnu66972/attachments/sejnu66972/CommunityNetworkin
gDiscussions/1027/1/455_Gerdes_20160624_1359.pdf Page 25 (annotated)

|	
[1.5] displaying an augmented reality image comprising at least a portion of the input image and an overlay image, corresponding to the retrieved digital	Defendant performs and induces others to perform the step of displaying an augmented reality image comprising at least a portion of the input image and an overlay image, corresponding to the retrieved digital data, positioned within the augmented reality image based on the decoded data from the DEM and the marker location, as defined by the at least one of the geographic coordinate data and the relative coordinate data, in the physical environment associated with the input image. This element is infringed literally, or in the alternative, under the doctrine of

data, positioned within the augmented reality image based on the decoded data from the DEM and the marker location, as defined by the at least one of the geographic coordinate data and the relative coordinate data, in the physical environment associated with the input image;	equivalents. For example, Vuforia View app displays an augmented reality (AR) image which comprises the scanned ThingMark ("a portion of input image") and an 3D representation of a virtual object (such as a truck). The overlay image comprises a 3D representation position within the AR image. The Vuforia View displays the 3D representation based on the ThingMark marker location and decoded x, y, and z coordinates. Source:
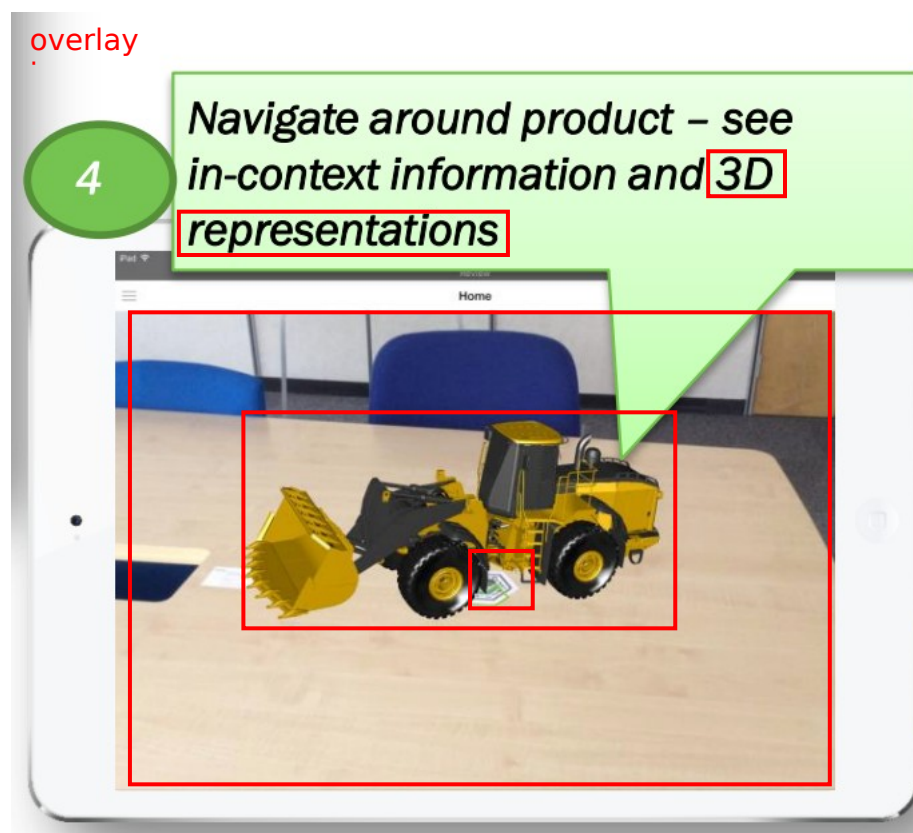
https://community.ptc.com/sejnu66972/attachments/sejnu66972/CommunityNetworkingDiscussions/1027/1/455_Gerdes_20160624_1359.pdf Page 10 (annotated)

Vuforia View Enterprise allows people to experience products in a whole **new way** using a **unique** approach that understands "Things".

Vuforia View Enterprise delivers **rich, use-case specific mobile user experiences** of seamlessly connected **product data**

These Experiences are enhanced by **3D product navigation** and **augmented reality** interaction.

Source:
https://community.ptc.com/sejnu66972/attachments/sejnu66972/CommunityNetworkingDiscussions/1027/1/455_Gerdes_20160624_1359.pdf Page 7

It's time to view the completed project!

1. Place the appropriate ThingMark on a flat surface where you can easily interact with it.
2. From your supported mobile device, open Vuforia View.
3. Point the camera of your device at the ThingMark.
4. Vuforia View alerts you with a sound or vibration once the ThingMark has been scanned successfully, and a list of available experiences appears. The experiences in the list have all been associated with the particular ThingMark that you scanned.
5. Select the **Blue Pump Demo** experience you just published.
6. Wait a moment with your device still pointed at the ThingMark.

   💬   If the model is large, a progress indicator appears. Try not to move the mobile device until this loading process completes.

   Slowly move your mobile device further away from the ThingMark so that you can view the entire experience.
7. Once the experience loads, you can interact with the various components of your AR experience:

   ◦ As you move the mobile device around (while still pointed at the ThingMark), the blue pump moves as well. This allows you to view the model from different angles.

   ◦ The 3D label displaying the RPM value is visible, and the value changes every 3 seconds. In addition, the 3D Label is always be facing towards you, regardless of how you move around the ThingMark.

   ◦ If you press the Play button one time, the disassembly animation plays. If you press the Play button a second time, the pump reassembles itself.

   ◦ If you press the Info button, the card appears in the middle of the screen with the information you added. If you press the Info button again, the information disappears.

   ◦ If you press the "i" button, the 3D Label appears or disappears each time your press it.

Source:
http://support.ptc.com/help/vuforia/studio/en/index.html#page/Studio_Help_Center/BPAdvancedViewInView.html

28

What Does This Widget Do?

The ThingMark widget allows you to insert a ThingMark in an experience.

A ThingMark is a uniquely identifiable marker that is universally recognizable by Vuforia View. ThingMarks must be recognizable to Vuforia View in order for the appropriate experiences and corresponding data to be delivered for the specific thing and use case.

When Should I Use This Widget?

Use a ThingMark when:

- You want to align your physical object and digital model as closely as possible. In order for the 3D model to display in the correct location, you must place a digital ThingMark in the same location as your real-world ThingMark. For example, if you want to create an experience showing a service technician how to change the oil filter on a generator, you will want to augment the oil filter model and sequence of steps on top of the physical generator.
- You want to create a tabletop experience. For example, if you want to show a potential customer a model of a generator without having to bring the physical generator, you would place the ThingMark on the floor of the canvas in the experience. Then, when on site, you would place the print out of the ThingMark on the floor, scan it, and the digital representation of the generator appears.

Source:
http://support.ptc.com/help/vuforia/studio/en/index.html#page/Studio_Help_Center%2FWidget3DMarker.html%23

Are There Any Special Properties, Services, Events, or Actions?

To view a list of common widget properties, services, and events, see Common Widget Properties, Services, and Events.

The following table is a list of properties that are specific to this widget.

Source:
http://support.ptc.com/help/vuforia/studio/en/index.html#page/Studio_Help_Center%2FWidget3DMarker.html%23

29

Property	JavaScript	Type	Description
ThingMark	markerId	string	ID of the ThingMark being used.
Marker Width	width	number	The width of the ThingMark. The value of this field is set in meters. For example, if your printed ThingMark is 5 centimeters, set this to 0.05.
X Coordinate	x	number	Location of the ThingMark on the x-axis.
Y Coordinate	y	number	Location of the ThingMark on the y-axis.
Z Coordinate	z	number	Location of the ThingMark on the z-axis.
X Rotation	rx	number	Rotation of the ThingMark about the x-axis.
Y Rotation	ry	number	Rotation of the ThingMark about the y-axis.
Z Rotation	rz	number	Rotation of the ThingMark about the z-axis.
Tracked	istracked	boolean	Tracked and Tracking Lost bindings.
Display Tracking Indicator	trackingIndicator	boolean	Displays an indicator that tracking is in progress.
Stationary (Eyewear projects only)	stationary	boolean	Select this checkbox if the ThingMark will be in a stable environment and won't be moved by the user.

decoded data from DEM defined by relative coordinate data

Source: http://support.ptc.com/help/vuforia/studio/en/index.html#page/Studio_Help_Center%2FWidget3DMarker.html%23 (annotated)

ThingMarks

Available in **Vuforia Studio**

A **Thingmark** is image-based tracking with a coded marker. It is a uniquely identifiable marker that is universally recognizable by **Vuforia View** (viewing application for Vuforia Studio). It enables IoT data to be visualized based on the specific asset that the AR experience corresponds to.

Thingmarks are predominantly used in scenarios where customers want to place virtual product visualizations or AR experiences on a surface when the physical object is not present.

Source: https://www.ptc.com/en/products/vuforia/augmented-reality-features

Augmented reality allows visual, digital content to be displayed over the physical world to enhance an experience. This technology can be used for shopping, entertainment, or in the workplace. Industrial augmented reality is the use of this interactive technology for use cases in manufacturing, service, and operations to improve workforce efficiency. When combined with enterprise IoT, PLM, and CAD data, Industrial AR can be a powerful tool for upskilling your workforce, optimizing operations, and increasing revenue.

Source: https://www.ptc.com/en/technologies/augmented-reality

Enrich User Experiences

Leverage innovative tracking methods for faster target identification, precise digital overlays and placing 3D virtual products into real-world environments. **Explore more**.

Source: https://www.ptc.com/en/products/vuforia/vuforia-studio

31

[1.6] wherein the overlay image is positioned within the augmented reality image using the at least one of the geographic coordinate data and the relative coordinate data.	Defendant performs and induces others to perform the step of displaying the augmented reality image wherein the overlay image is positioned within the augmented reality image using the at least one of the geographic coordinate data and the relative coordinate data. This element is infringed literally, or in the alternative, under the doctrine of equivalents. For example, the Vuforia View app displays the augmented reality image in which the 3D representation ("overlay image") is positioned on the location represented by the x, y, and z coordinates ("relative coordinate data") of ThingMark. Source:

https://community.ptc.com/sejnu66972/attachments/sejnu66972/CommunityNetworkingDiscussions/1027/1/455_Gerdes_20160624_1359.pdf Page 10 (annotated)

Use a ThingMark when:

- You want to align your physical object and digital model as closely as possible. In order for the 3D model to display in the correct location, you must place a digital ThingMark in the same location as your real-world ThingMark. For example, if you want to create an experience showing a service technician how to change the oil filter on a generator, you will want to augment the oil filter model and sequence of steps on top of the physical generator.

- You want to create a tabletop experience. For example, if you want to show a potential customer a model of a generator without having to bring the physical generator, you would place the ThingMark on the floor of the canvas in the experience. Then, when on site, you would place the print out of the ThingMark on the floor, scan it, and the digital representation of the generator appears.

Source:
http://support.ptc.com/help/vuforia/studio/en/index.html#page/Studio_Help_Center%2FWidget3DMarker.html%23

Are There Any Special Properties, Services, Events, or Actions?

To view a list of common widget properties, services, and events, see Common Widget Properties, Services, and Events.

The following table is a list of properties that are specific to this widget.

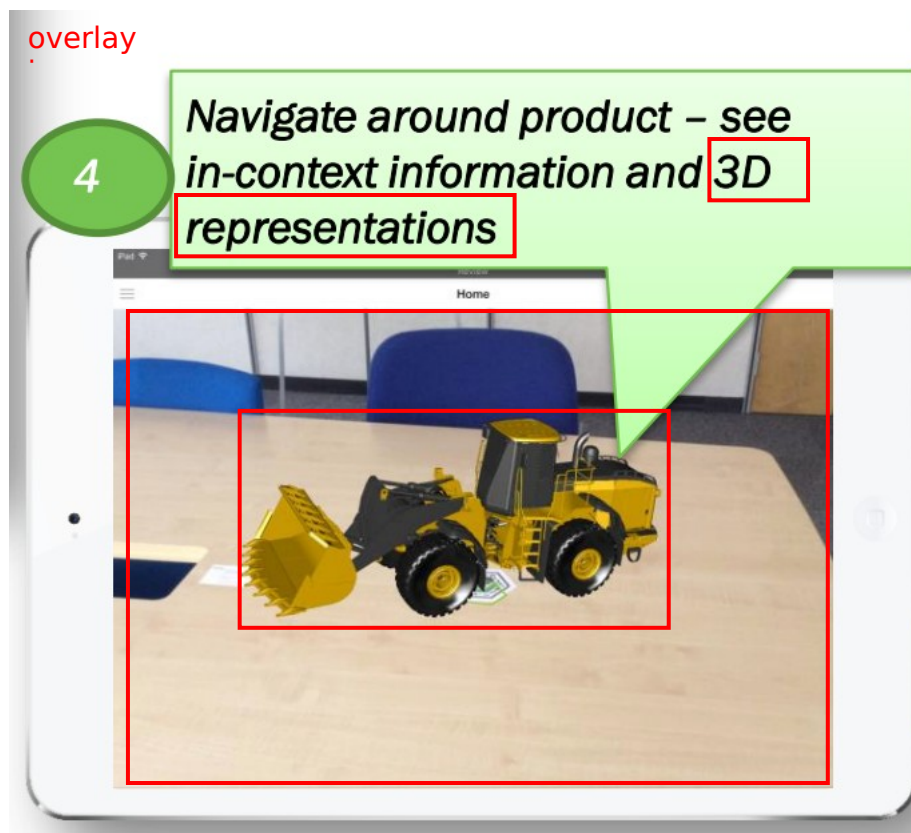Source:
http://support.ptc.com/help/vuforia/studio/en/index.html#page/Studio_Help_Center%2FWidget3DMarker.html%23

Property	JavaScript	Type	Description
ThingMark	markerId	string	ID of the ThingMark being used.
Marker Width	width	number	The width of the ThingMark. The value of this field is set in meters. For example, if your printed ThingMark is 5 centimeters, set this to 0.05.
X Coordinate	x	number	Location of the ThingMark on the x-axis.
Y Coordinate	y	number	Location of the ThingMark on the y-axis.
Z Coordinate	z	number	Location of the ThingMark on the z-axis.
X Rotation	rx	number	Rotation of the ThingMark about the x-axis.
Y Rotation	ry	number	Rotation of the ThingMark about the y-axis.
Z Rotation	rz	number	Rotation of the ThingMark about the z-axis.
Tracked	istracked	boolean	Tracked and Tracking Lost bindings.
Display Tracking Indicator	trackingIndicator	boolean	Displays an indicator that tracking is in progress.
Stationary (Eyewear projects only)	stationary	boolean	Select this checkbox if the ThingMark will be in a stable environment and won't be moved by the user.

relative coordinate data decoded from the

Source:
http://support.ptc.com/help/vuforia/studio/en/index.html#page/Studio_Help_Center%2FWidget3DMarker.html%23 (annotated)

| [1.7] wherein the displaying further comprises registering the at least one of the geographic coordinate data and the relative coordinate data, decoded from the DEM, to relative coordinates in the | Defendant performs and induces others to perform the step of the displaying further comprises registering the at least one of the geographic coordinate data and the relative coordinate data, decoded from the DEM, to relative coordinates in the augmented reality image.

This element is infringed literally, or in the alternative, under the doctrine of equivalents.

For example, the Vuforia View app displays an augmented reality (AR) image which includes the scanned ThingMark and the overlay image. The overlay image comprising the 3D representation is placed on top of the ThingMark and if the user moves the mobile device, the 3D representation moves as well to stay on the ThingMark. |

augmented reality image.	Therefore, the relative coordinate data decoded from ThingMark is registered to the relative coordinates in the augmented reality image for the 3D representation to be placed at the appropriate location.
	overlay Navigate around product – see in-context information and 3D representations augmented reality Source: https://community.ptc.com/sejnu66972/attachments/sejnu66972/CommunityNetworkingDiscussions/1027/1/455_Gerdes_20160624_1359.pdf Page 10 (annotated)

It's time to view the completed project!

1. Place the appropriate ThingMark on a flat surface where you can easily interact with it.
2. From your supported mobile device, open Vuforia View.
3. Point the camera of your device at the ThingMark.
4. Vuforia View alerts you with a sound or vibration once the ThingMark has been scanned successfully, and a list of available experiences appears. The experiences in the list have all been associated with the particular ThingMark that you scanned.
5. Select the **Blue Pump Demo** experience you just published.
6. Wait a moment with your device still pointed at the ThingMark.

   💬   If the model is large, a progress indicator appears. Try not to move the mobile device until this loading process completes.

   Slowly move your mobile device further away from the ThingMark so that you can view the entire experience.
7. Once the experience loads, you can interact with the various components of your AR experience:
   ◦ As you move the mobile device around (while still pointed at the ThingMark), the blue pump moves as well. This allows you to view the model from different angles.

   ◦ The 3D label displaying the RPM value is visible, and the value changes every 3 seconds. In addition, the 3D Label is always be facing towards you, regardless of how you move around the ThingMark.

   ◦ If you press the Play button one time, the disassembly animation plays. If you press the Play button a second time, the pump reassembles itself.

   ◦ If you press the Info button, the card appears in the middle of the screen with the information you added. If you press the Info button again, the information disappears.

   ◦ If you press the "i" button, the 3D Label appears or disappears each time your press it.

Source:
http://support.ptc.com/help/vuforia/studio/en/index.html#page/Studio_Help_Center/
BPAdvancedViewInView.html

36

What Does This Widget Do?

The ThingMark widget allows you to insert a ThingMark in an experience.

A ThingMark is a uniquely identifiable marker that is universally recognizable by Vuforia View. ThingMarks must be recognizable to Vuforia View in order for the appropriate experiences and corresponding data to be delivered for the specific thing and use case.

When Should I Use This Widget?

Use a ThingMark when:

- You want to align your physical object and digital model as closely as possible. In order for the 3D model to display in the correct location, you must place a digital ThingMark in the same location as your real-world ThingMark. For example, if you want to create an experience showing a service technician how to change the oil filter on a generator, you will want to augment the oil filter model and sequence of steps on top of the physical generator.

- You want to create a tabletop experience. For example, if you want to show a potential customer a model of a generator without having to bring the physical generator, you would place the ThingMark on the floor of the canvas in the experience. Then, when on site, you would place the print out of the ThingMark on the floor, scan it, and the digital representation of the generator appears.

Source:
http://support.ptc.com/help/vuforia/studio/en/index.html#page/Studio_Help_Center%2FWidget3DMarker.html%23

Are There Any Special Properties, Services, Events, or Actions?

To view a list of common widget properties, services, and events, see Common Widget Properties, Services, and Events.

The following table is a list of properties that are specific to this widget.

Source:
http://support.ptc.com/help/vuforia/studio/en/index.html#page/Studio_Help_Center%2FWidget3DMarker.html%23

37

Property	JavaScript	Type	Description
ThingMark	markerId	string	ID of the ThingMark being used.
Marker Width	width	number	The width of the ThingMark. The value of this field is set in meters. For example, if your printed ThingMark is 5 centimeters, set this to 0.05.
X Coordinate	x	number	Location of the ThingMark on the x-axis.
Y Coordinate	y	number	Location of the ThingMark on the y-axis.
Z Coordinate	z	number	Location of the ThingMark on the z-axis.
X Rotation	rx	number	Rotation of the ThingMark about the x-axis.
Y Rotation	ry	number	Rotation of the ThingMark about the y-axis.
Z Rotation	rz	number	Rotation of the ThingMark about the z-axis.
Tracked	istracked	boolean	Tracked and Tracking Lost bindings.
Display Tracking Indicator	trackingIndicator	boolean	Displays an indicator that tracking is in progress.
Stationary (Eyewear projects only)	stationary	boolean	Select this checkbox if the ThingMark will be in a stable environment and won't be moved by the user.

relative coordinate data decoded

Source:
http://support.ptc.com/help/vuforia/studio/en/index.html#page/Studio_Help_Center%2FWidget3DMarker.html%23 (annotated)

38

Source:
https://community.ptc.com/sejnu66972/attachments/sejnu66972/CommunityNetworkingDiscussions/1027/1/455_Gerdes_20160624_1359.pdf Page 32

Source:
https://community.ptc.com/sejnu66972/attachments/sejnu66972/CommunityNetworkingDiscussions/1027/1/455_Gerdes_20160624_1359.pdf Page 25 (annotated)

3D Image

What Does This Widget Do?

The 3D Image widget allows you to insert a 3D image on the 3D canvas of an AR experience. Supported file formats include:

- .png
- .jpg, .jpeg
- .svg
- .gif
- .bmp

When Should I Use This Widget?

Use an Image when you want to display 3D graphical content or pictures to a user. For example, if you're trying to describe what a dirty air filter looks like to a service technician, it may be easier just to include an image of a dirty air filter.

Are There Any Special Properties, Services, Events, or Actions?

To view a list of common widget properties, services, and events, see Common Widget Properties, Services, and Events.

The following table is a list of properties that are specific to this widget.

Source:
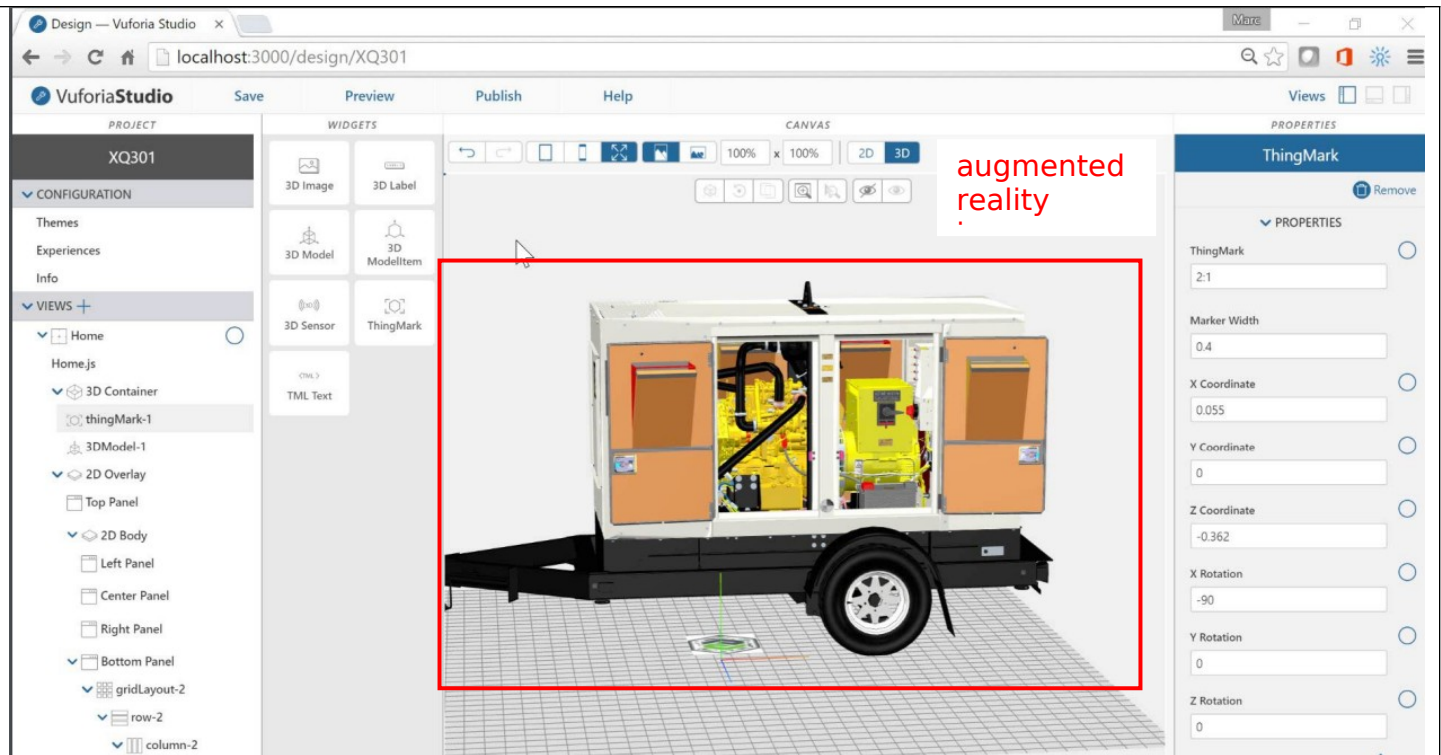http://support.ptc.com/help/vuforia/studio/en/index.html#page/Studio_Help_Center%2FWidget3DImage.html%23wwID0ER5PR

Scale	Scale of the 3D image.
X Coordinate	Location of the image on the x-axis.
Y Coordinate	Location of the image on the y-axis.
Z Coordinate	Location of the image on the z-axis.
X Rotation	Rotation of the image about the x-axis.
Y Rotation	Rotation of the image about the y-axis.
Z Rotation	Rotation of the image about the z-axis.
Billboard	Rotates a widget around its center so it is always facing the viewer. It is aligned with the screen.
Occluding	If selected, the geometry of a widget is invisible, but at the same time hides any other augmentations behind it in the 3D scene. Therefore, the background or camera feed appears where the occluded widget should be. This can be used to emphasize some augmentations by hiding surrounding 3D geometry.
Always on top	Overlays the widgets geometry on any other augmentations in the scene regardless of its depth in the 3D scene. If set to **Yes**, it will not be hidden by other augmentations. Typically this can be used for labels or sensors that must always remain visible.
Opacity (1 Opaque - 0 Transparent)	A number between 0 and 1 that controls the level of transparency of the object. 0=completely transparent and 1=completely opaque.

Source:
http://support.ptc.com/help/vuforia/studio/en/index.html#page/Studio_Help_Center%2FWidget3DImage.html%23wwID0ER5PR

42

2. List of References

1. https://community.ptc.com/sejnu66972/attachments/sejnu66972/CommunityNetworkingDiscussions/1027/1/455_Gerdes_20160624_1359.pdf, last accessed on June 16, 2023.
2. http://support.ptc.com/help/vuforia/studio/en/index.html#page/Studio_Help_Center%2FWidget3DMarker.html%23, last accessed on June 16, 2023.
3. https://www.ptc.com/en/products/vuforia/vuforia-studio, last accessed on June 16, 2023.
4. https://www.ptc.com/en/products/vuforia/augmented-reality-features, last accessed on June 16, 2023.
5. https://www.ptc.com/en/technologies/augmented-reality, last accessed on June 16, 2023.
6. https://www.ptc.com/en/success-paths/develop-first-vuforia-studio-experience/setup/get-started-with-devices, last accessed on June 16, 2023.
7. https://play.google.com/store/apps/details?id=com.ptc.vuforiaview&hl=en&gl=US, last accessed on June 16, 2023.